

Studying ICT supported pedagogical practices

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Abstract

During the past decade there has been an exponential growth in the use of information and communication technology (ICT) and this has made pervasive impacts both on the society and on our daily lives. It is thus not surprising to find increasing interest, attention and investment put into the use of ICT in education all around the world. In addition to efforts to make use of ICT to improve learning, the emergence of the knowledge economy has also brought about in recent years a much greater emphasis on education and a number of masterplans in ICT in education has been produced in many countries. Such masterplans detailed not only strategies for implementation but more importantly embedded the plans within a broader framework of education reform that aimed to develop students' capacities for self-learning, problem-solving, information seeking and analysis, critical thinking and the ability to communicate, collaborate and learn via the internet, abilities that figured much less importantly in the school curricula before. In this context, a new term, "emerging pedagogical practice", was used in SITES (the Second International Information Technology in Education Study, conducted under the auspices of the IEA) (Pelgrum, 1999) to highlight the changing pedagogical goals and practices that has resulted from the use of ICT in education, as opposed to those uses that just aimed at enhancing the effectiveness of "traditionally important pedagogical practices".

However, the concept of "emerging pedagogical practice" as depicted in the SITES Module 1 (M1) report is still rather vague. When schools have access to computers and the Internet to support teaching and learning, how would teachers and students make use of them? What impact has ICT made on classroom practices? What changes, if any, has ICT made on the roles of teachers and students and the interactions between them? Has the introduction of ICT in schools brought about the desired education reforms envisaged in the ICT in education masterplans or are these wishful optimisms? Are there more effective models of ICT implementation in schools, and if so what are their characteristics? In conjunction with the SITES M1 Hong Kong study, we have conducted a study of good practices in the use of ICT for teaching and learning using the case studies approach. The main goal of this extension study was to explore the above questions in the context of good practices as commonly recognized by members of the education community, and to develop ways of disseminating such good practices. This paper describes the conceptual framework and methodology used in this study and reports briefly on some key findings from the study.

The research methodology used in this Study is based on a model of pedagogical practice that is couched within a broad curriculum framework where the pedagogical practice is the implemented curriculum. There are two parts to the research. The first part is to investigate and to build models of pedagogical practices involving use of ICT. Here the assumption (substantiated by observations) is that the way ICT is incorporated into classrooms is very much dictated by the teachers' general beliefs and approaches to education. The second component of the methodology deals with the models (strategies) of educational change used in different schools in introducing ICT across the curriculum and to explore if particular models of

pedagogical practice is linked with specific school implementation strategies.

Introduction

Over the past decade, there has been an exponential growth in the use of information and communication technology (ICT) and this has made pervasive impacts both on the society and on our daily lives. The rapid technological developments catapulted us into the era of 'information age' and have made a variety of significant impacts on life in the modern society. It is widely believed that students in this information age will require not just a larger set of facts or a larger repertoire of specific skills, but the capacity to readily acquire new knowledge, to solve new problems and to employ creativity and critical thinking in the development of new approaches to the solution of new and existing problems. In response to this, schools should help students to develop life-long learning abilities and equip them to cope with the challenges of the 21st century. It is thus not surprising to find increasing interest, attention and investment put into the use of ICT in education all around the world. In addition to efforts to make use of ICT to improve learning, the emergence of the knowledge economy has also brought about in recent years a much greater emphasis on education and masterplans on ICT in education has been produced in many countries. Such masterplans detailed not only strategies for implementation but more importantly embedded the plans within a broader framework of education reform that aimed to develop students' capacities for self-learning, problem-solving, information seeking and analysis, critical thinking and the ability to communicate, collaborate and learn via the internet, abilities that figured much less importantly in the school curricula before.

It is not surprising that educators and policy makers, and business and other community groups are looking to technology as a tool for reshaping and improving education. How can technology support this transformation? Research shows that instructional impacts made by technology are inseparably associated with the way the technology is used and in the activity structure that surrounds it, rather than with the hardware or software itself (Means, 1993). A new term "emerging pedagogical practice" was used in SITES, (derived from (Pelgrum, 1997)) to highlight the changing pedagogical goals and practices that has resulted from the use of ICT in education as opposed to those uses that aimed at just enhancing the effectiveness of "traditionally important pedagogical practices".

(Pelgrum, 1997) characterized the practices having "emerging paradigm" as those possessing "emerging" characteristics for the school (which is integrated in society and having information openly available), the teacher (who emphasizes communication skills, guides independent learning, helps students to find the appropriate instructional path and to evaluate own progress), the student (who is actively involved in own learning, asks questions, seeks answers, engages in teamwork and learns both at and outside of school) and the parent (who actively participates in and co-steers the child's learning process). However, what this description of "emerging paradigm" will translate into in terms of pedagogical practice is still not clear. Now that most schools have access to computers and the Internet to support teaching and learning, how do teachers and students make use of them? What impact has ICT made on classroom practices? What changes, if any, has ICT made on the roles of teachers and students and the interactions between them? Can we discern distinctly different paradigmatic pedagogical practices when ICT is used in teaching and learning situations as suggested? If so, what are their respective observable characteristics? While the above questions concern implementations at the classroom level, this cannot be dissociated from implementation strategies at the school level. Are there more effective models of ICT implementation in schools, and if so what are their

characteristics? How will the implementation strategies affect the pedagogical practice paradigm of ICT use in the classroom? These questions were explored in the Local Extension Study of the Second International Information Technology in Education Study (SITES) in Hong Kong. The aims of this study is two folded: (1) to deepen our understanding of the impacts of implementing ICT on pedagogical practices at the classroom level; (2) to describe and examine the factors contributing to successful implementation of good practices identified. This Study employs a case study approach to investigate both the classroom practices and the school implementation strategies.

Conceptual framework

This study is by nature an exploratory qualitative study to investigate good practices of ICT use in the classrooms, with particular focus on the nature and characteristic of the pedagogical practices and the factors that affect the implementation process.

Much of the existing literature on educational uses of ICT categorizes the modes of usage according to the function played by the technology, e.g. as tutor, tool or tutee (Taylor, 1980), as cognitive tools (Solomon, 1986) or mindtools (Jonassen, 2000). Such categorizations are very useful when one is conceptualizing the role that technology plays in the teaching and learning process or when designing or selecting technology tools for education. However, as Jonassen (1999) eloquently pointed out, educational uses of technology that strive to be “teacher-proof” or “learner-proof” do not exploit the capabilities of the technologies or the students. In designing effective learning experiences supported by technology, it is important not only to choose the appropriate technological tool, but also to have a clear understanding of the roles played by the teacher, the learner and the technology. In fact, the fundamental assumption underlying the concept of “emerging pedagogical paradigm” is that with the introduction of technology into the teaching and learning process, the roles played by the teacher and the learner should and needs to change. Thus, we take the view that a study of ICT supported pedagogical practices should not focus on the functional characteristics of the technology used but rather the roles played by the three actors, the teacher, the learners and the technology used, as well as the interactions between them. As depicted in Figure 1, the actual implemented curriculum will be affected by the idiosyncratic factors associated with each of the three actors present in any specific situation, for example the academic, professional and technological background and the pedagogical orientation of the teacher, the academic and technical competence of the learners as well as their family background and support, the technological infrastructure and technical support available.

Conceptual framework for studying pedagogical practices

The focus in this study is on ICT supported pedagogical practices that are integral to the organized teaching and learning situations in schools as part of the formal school curriculum, even though the learning can be extended to situations outside of the classroom. It is thus appropriate and important that this study be conducted within a broad curriculum framework. In fact, pedagogical practices can be interpreted as synonymous to the “implemented curriculum” within a broad framework which distinguishes three dimensions of curriculum description: the intended, the implemented and the achieved curriculum (e.g. Robitaille, 1996). The intended curriculum refers to the curriculum schools intend to realize, which is generally described in terms of achievement targets and educational processes defined at the national/school system level. At the classroom level, the intended curriculum refers to the learning goals or objectives of a lesson. The second dimension, the implemented curriculum,

refers to the educational processes happening at the school and classroom levels. It can be described in terms of learning opportunities offered to students. The third dimension, the attained curriculum, refers to students' learning outcomes achieved from the learning experiences at school or classroom levels.

Figure 1 [Diagrammatic representation of the framework for conceptualizing and analyzing ICT supported pedagogical practices in school settings.](#)

While the description of any pedagogical practice is essentially concerned with the relationship between the teacher and the learners, such practices take place in the complex milieu of the school context, which is also influenced by external forces at district/regional/national levels. Thus the entire curriculum context for studying ICT supported pedagogical practices has to be examined within the three levels of context: classroom, school and community (which may include regional/country influences). These three levels are mutually interacting and the boundaries between them are not distinct. Pedagogical practices as an implementation of the school curriculum are necessarily affected by educational policies at the country/regional level which normally provides the framework for the intended curriculum. The school leadership and aspirations affect the intended curriculum at the school level. Instantiations of the intended curriculum as actual pedagogical practices depend not only on the classroom level factors but also on the school culture, which encompasses values, approaches and relationships amongst teachers and students. The local community, often represented by stakeholders such as parents and old students' associations may also contribute to the formulation of school policies and aspirations as well as to the provision of enriched technology infrastructure and support.

Conceptual framework for studying ICT-related school change

The implementation of ICT supported pedagogical practices as an integral part of the school curriculum is thus not a simple adoption of new technology but must be understood within the context of educational change. As Fullan (1991, 1999) pointed out, successful implementation of educational change is a complex process with no clear solution. This framework can also be used to capture the specific change strategies adopted in different school settings. Change leadership at the school level involves the provision and manipulation of different factors associated with the entire curriculum process from intended to implemented to achieved curriculum. Such factors include school-based curriculum goals and resource development, ICT infrastructure, staff development, staff appraisal and incentives policies, assessment goals, methods and policies. Obviously, the change strategy is very much influenced by the vision and goals of the leadership as these determine the change priorities, thus influencing the choice of factors to designate as key change factors.

Defining “good practices”

As mentioned earlier, the main motivation of this study was to study examples of good practices in using ICT in teaching and learning with the aim of disseminating the experiences so gained. A most challenging question facing the research team was how do one identify good practices and what criteria should one use to identify such. Whilst one may attempt to equate good practices with those that exhibit characteristics of the “emerging paradigm”, the research team

decided against setting up any conceptual criteria for case selection. Instead the team just solicited widely through various knowledgeable contacts such as Education Department officials working in the area of ICT in education, and members of various education organizations for nominations of schools or teachers they know to be actively integrating the use of ICT in teaching and learning and may act as good role models for others. This simple and atheoretical criteria is chosen because at the time of the study (April 1999 to March 2000), Hong Kong schools has only just begun to introduce the use of ICT across the curriculum, following the release of the 5-yr IT in education strategy plan in November 1998. Given such a short history of this innovation, we decided that the best way to learn from practice is to do a naturalistic study of how teachers teach with ICT and how schools implement change, irrespective of whether those practices exhibit features of the “emergent” or the “traditionally important” paradigm.

Research Methods

As the main aim of the study was to learn from the rich and complex experiences of schools in their efforts to integrate ICT in their teaching and learning activities in the school, description and interpretation are the main concern rather than measurement and prediction. As such, multiple-case qualitative study was considered by the team to be the most appropriate approach to employ. Case studies are often used in qualitative research to look for ‘depth’ of reality’ and the use of multiple-case study is not to calculate tendency or frequency, but rather, to compare and contrast. It would be fruitful to compare and contrast different ways teachers and students make use of technology in curriculum contexts and the different implementation strategies their schools use to enable such practices to take place.

Definition of a case

As the focus of this study is on the implemented curriculum, it was decided that the key unit of observation and analysis should appropriately be defined as the enactment of a small intact curriculum theme/topic at the classroom level (a pedagogical practice), which may be one or a small number of lessons with clearly stated lesson objectives. Here, the “classroom” is interpreted in a loose sense such that it defines a group of students learning the topic together, but may involve activities that go beyond the physical classroom as well as individuals/groups outside of the school.

While the key focus of a case is a pedagogical practice, a complete case study includes studying the contextual factors at the school level. The concept used in the definition of a case is that of “zooming out”: in order to really understand the conditions for emergence, sustainability and transferability for these practices, one need to find out about important aspects of the school context – the goals and vision of the school, the ICT implementation history and strategy including infrastructure, funding, staffing provisions, staff development and other related initiatives in the school.

Case selection

The research team devoted considerable effort to choosing cases that would provide a range of worthwhile examples reflecting the widest range of teaching approaches we came across as well as providing examples across different grade levels and school subject areas. Since the type of school would affects the design, implementation and impact of technology application, we made an effort to include primary, secondary pilot and non-pilot schools, grammar and prevocational schools, Chinese medium and English medium schools as well as special schools.

Data collection and analysis

A case study may employ various means for data collection. For this study, classroom observations, videotapes of the lesson(s), interviews and documentary information from the schools were important data sources used. The details of the data collection and analysis would not be reported here. Suffice to point out that the conceptual framework served as the basis on which the research and analysis methods were developed.

Findings: Categories of ICT-supported Pedagogical Practices at Classroom Level

As mentioned earlier in the conceptual framework, a study of ICT supported pedagogical practices should not focus on the functional characteristics of the technology used but rather the roles played by the three actors, the teacher, the learners and the technology, as well as the interactions between them. Given such a focus, we found that irrespective of the kind of pedagogical practice used, it was the teacher who made the key pedagogical decisions, which largely depends on the beliefs and orientations of the teacher. In fact, the technology used in the classroom is only one of the many decisions made by the teacher in order to conduct the lesson on hand. We do not see evidence that the adoption of technology changed the pedagogical beliefs of the teachers but rather that technology was selected and adapted in line with the pedagogical approach deemed appropriate by the teacher. After initial rounds of analysis, it was decided that the pedagogical practices could be best categorized according to the pedagogical approaches, with attendant descriptions of the characteristics and roles of the actors as well as their interactions.

Using this framework of analysis, we found five pedagogical approaches in the classrooms we studied. It is important to note here that these five approaches are by no means exhaustive but happen to be the ones that we were able to come into contact with in the process of our study. The key distinguishing factors between the approaches were the roles played by the teacher and the students in the classroom as well as the nature of the learning outcome being targeted. Each approach reflects the belief of the teacher on how learning takes place and this gave rise to the patterns and functions of the teacher's talk, the learning activities employed, the levels of demands on students and the intended learning outcomes.

The five pedagogical approaches observed of were (1) Expository Approach, (2) Resource-based Inductive Approach, (3) Task-based Approach, (4) Problem-based Approach and the (5) Social-Constructivist Approach. Table 1 is a summary of the key features of these five approaches. It is important to note from the Table that the kinds of learning goals being targeted by the teacher in these different practices are different and while some learning goals may be achieved by more than one approach, there are others that can only be achieved through specific approaches.

Table 1 Features of the five pedagogical approaches identified in the study.

	Expository Approach	Resource-based Inductive Approach	Task-based Approach	Problem-based Approach	Social-Constructivist Approach
Learning goals targeted	<ul style="list-style-type: none"> • Concepts • Facts • Procedural skills 	<ul style="list-style-type: none"> • Abstract concepts 	<ul style="list-style-type: none"> • Concepts • Skills • Application of complex concepts & skills for completion of productive tasks 	<ul style="list-style-type: none"> • Concepts & skills • Problem analysis and problem solving ability • Application of concepts and skills in solution of authentic problem 	<ul style="list-style-type: none"> • Concepts & skills • Problem solving abilities • Communication abilities • Ability to work collaboratively: negotiating meaning, and joint decision making in a team
Belief in Teaching and Learning	<ul style="list-style-type: none"> • learning is perceived mainly as a transmission of subject-based concepts and skills from teacher to students 	<ul style="list-style-type: none"> • learning is more effective when students experience the phenomena under study • teacher provides opportunity for students to generate hypothesis and concepts through experiential activities. 	<ul style="list-style-type: none"> • deep and significant learning is perceived to take place through integrating new learning in purposeful tasks requiring the integration of new knowledge and skills with existing ones in meaningful contexts. 	<ul style="list-style-type: none"> • similar to task-based approach, but tasks are more open while problems need refinement and interpretation, and provide criteria for assessing outcome. • Values and develop ability to monitoring learning 	<ul style="list-style-type: none"> • learning is best achieved by sharing, discussing and critically reviewing own and others' ideas/products • often integrated with one of the other approaches except the expository approach
Role of Teachers	<ul style="list-style-type: none"> • subject expert • presenter • evaluator of learning • provision of feedback 	<ul style="list-style-type: none"> • to ascertain the prior concepts of students • design learning experiences and direct students' attention • pose questions to stimulate formulation and exploration of ideas 	<ul style="list-style-type: none"> • design purposeful tasks, has a constructionist orientation • provide opportunities for students to present finished work and the ideas encompassed 	<ul style="list-style-type: none"> • design authentic problems that pose the right challenge for students • pose probing questions to stimulate formulation of problem & solution strategy • monitor & facilitate learning process 	<ul style="list-style-type: none"> • depending on the approach that this is coupled with, the teacher will undertake that accordingly • design collaborative learning tasks for students • stimulate sharing and mutual critique of ideas
Role of Students	<ul style="list-style-type: none"> • retain in memory, retrieve and apply the concepts and skills taught 	<ul style="list-style-type: none"> • engage actively in the learning activities to generate ideas and hypothesis • explore and consider alternative ideas to develop a better understanding of ideas taught 	<ul style="list-style-type: none"> • internalize key concepts/ skills taught and integrate with knowledge & skills already possessed for productive completion of task. 	<ul style="list-style-type: none"> • Engage actively in the interpretation and definition of problem, development of solution strategies. • apply knowledge from a variety of disciplines to solve problem • monitor and review solution and solution process 	<ul style="list-style-type: none"> • co-construct understanding with peer learners. • justify own view and respond to challenges • review own and others' work critically • formulate own views and judgement in the learning processes
Role of IT	<ul style="list-style-type: none"> • enhance presentation effectiveness • motivating students' interest through use of attractive animation, etc. • monitor and evaluate student progress 	<ul style="list-style-type: none"> • facilitative learning tools or databases that provide experiential input to the learner • support exploration of ideas by supporting presentation of students' ideas and their consequences 	<ul style="list-style-type: none"> • empowering tools and information resources for the students to achieve the set tasks • powerful and flexible medium for presentation of student work 	<ul style="list-style-type: none"> • empowering tools and information resources for the students to achieve the set tasks • analysis tools for problem solving • powerful and flexible medium for presentation of student work 	<ul style="list-style-type: none"> • support communication and sharing of ideas and resources • support co-construction of joint projects

Findings: Models of Change for ICT Implementation at School Level

In examining the history and backgrounds of the schools studied and the ICT implementation strategies used, we identified three models of change: the *Integration model*, the *Catalytic Integration model* and the *Technological Adoption model*. The key distinctions between these three models are the established vision and values of the school, the perceived role and impact of ICT on education and the established culture and reform history of the school. Given a specific set of contextual characteristics of a school, it seems apparent from the preliminary findings that the particular model of change adopted is consistent and predictable. As these change models determine much of the requisite contextual factors for ICT implementation at the classroom level, they need to be closely studied for effective measures to be set up on the dissemination of good practices. The key defining characteristics of the three change models identified are presented in Table 2.

Does the model of change for ICT Implementation at School Level affect Pedagogical Practices at Classroom Level

Preliminary analysis of the data reveal that there is close relationship between the model of change adopted for ICT implementation and the kinds of ICT supported pedagogical practices found in the school.

In schools where the *Integration Model* was adopted, there was no compulsory staff development program and the teachers were generally respected and trusted by the school leadership. These were generally the well-established schools with student intake generally at the upper ability levels. There was neither coercion nor encouragement for specific choices of pedagogical approaches and the use of ICT in teaching was generally encouraged and supported. The kind of pedagogical practice occurring in a particular classroom in the school largely depends on the belief of the teacher involved. Thus, in these schools, all varieties of approaches of can be found. In other words, the pedagogical practices within these schools are more diversified than those found in schools adopting the other two models. In fact, all the five pedagogical approaches identified in this study can be found in these schools. Another important feature of ICT use in these schools is that ICT tend to be heavily used by students in all sorts of extra-curricular activities and some very innovative projects involving multi-age students can be found.

In schools where the *Catalytic Integration Model* was adopted, there were strong curriculum leadership, including how ICT implementation should be developed and integrated with the entire school curriculum, from the principals. Teachers were used to continuous professional development programs organized by the school leadership which then became broadened to include ICT as an integral component. In these schools, the ICT supported pedagogical practices tended to emphasize more on student-centred approaches and frequently involve staff collaborations and curriculum innovations that were part of bigger reform projects. The pedagogical practices found in these schools were mostly Task-based, Problem-based and Social-Constructivist approaches.

Table 2: Key defining characteristics of the three change models identified in the study.

	Integration Model	Catalytic Integration Model	Technological Adoption Model
Main Features of the School	<ul style="list-style-type: none"> strong cultural and historical foundations well-established student organizations and good multiage interactions as “school tradition” 	<ul style="list-style-type: none"> characterized by a visionary leadership and a school philosophy which engages the school in a continuous reform process, and achieves that through engaging teachers in the process as members of a learning organization 	<ul style="list-style-type: none"> does not have a strong school tradition or distinct education philosophy teachers and students may have individual goals but generally not articulated and no alignment of education philosophy evident
School Vision and Philosophy	<ul style="list-style-type: none"> realization of students’ individual potentials and development of self-actualization, life-long learning ability most emphasized a culture of mutual support and trust is essential, both for teachers and for students the most important condition for good teaching and learning in a school is the provision of a resource-rich, supportive environment for both teachers and students development and change should be achieved through encouragement rather than intervention and coercion 	<ul style="list-style-type: none"> the school should provide learning opportunities for students so that graduating students can possess a minimum set of core competencies and abilities as well as the confidence and appropriate attitude to adequately face the challenge of adult life these goals can only be achieved through the provision of a well designed curriculum that comprises of suitably designed learning experiences supported by appropriate assessment policies and infrastructure 	<ul style="list-style-type: none"> The public statements of vision and goals of the school generally echo those promoted by the school sponsoring organizations and the government. Such statements do not seem to figure much in the consciousness of the teachers or students in discussions about teaching and learning in the school, as distinct from the other two models.
Role of ICT in Teaching and Learning	<ul style="list-style-type: none"> ICT is mainly seen as an empowering tool both for students and teachers Introduction of ICT is generally seen as the introduction of a powerful and versatile tool In line with the non-coercive culture of the school, the introduction of ICT is not seen as a threat but became integrated by individuals into their existing practices 	<ul style="list-style-type: none"> a clear and positive vision of ICT as a catalyst for accelerating and realizing the goals and vision of the school. The most important impact of ICT is seen as the emergence of the information society, which accentuates the need to help students develop life long learning and problem solving abilities The use of ICT in teaching and learning is deliberate and designed as an integral part of the curriculum consistent with the school ethos 	<ul style="list-style-type: none"> enhancing teaching effectiveness and ICT competence of students are perceived as the main objectives of ICT implementation in the school
Change Agents & Strategies of ICT Implementation	<ul style="list-style-type: none"> culture of developing individual potential and support for self- actualization is applicable to teachers as well, resulting in natural evolution of an active group of ICT-using teachers who became the IT team in the school Role of principal and IT were both seen as essentially supportive in ensuring infrastructure provisions and staff development support (technical training) Students: are encouraged and supported in using ICT even in extracurricular projects 	<ul style="list-style-type: none"> The principal is the key change agent who have a clear vision and implementation strategy, with staff professional development being the most important element With the reform history in the school, there are existing change agents involved in curriculum reform and development that now leads ICT implementation as well since ICT is seen as a catalyst for school reform More technically competent students became recruited as part of the human resource for technological support for the teaching and learning process 	<ul style="list-style-type: none"> Principal as main change agent Teachers involved in the ICT implementation, clearly led by the top-down expectation of the school principal often has clearly defined targets and timetable for achieving specific ICT competencies and demonstration of such use in classrooms
Staff Development	<ul style="list-style-type: none"> no compulsory staff development program, provision of technically oriented courses 	<ul style="list-style-type: none"> provision of staff development programs with emphasis on curriculum and pedagogy to make best use of ICT 	<ul style="list-style-type: none"> provision of technical and skill based training

In schools where the *Technological Adoption Model* was adopted, Expository and Resource-based Inductive approaches were the most commonly found pedagogical practices. The role of teachers was mainly seen as that of a good presenter and evaluator of learning. The main role of ICT was to enhance the effectiveness of information presentation and to stimulate student interest using good multimedia, especially graphics and animation. Technology can also be used to relieve teachers of the tedious repetitive work in monitoring and providing feedback to student exercises. An important function of teachers in the IT age was seen as the producer of good ICT-based learning resources and thus an important part of staff development in these schools was that of authoring multimedia course. The ability to produce “interactive” (meaning able to provide feedback on correctness of students’ input) multimedia is a kind of necessary pinnacle for teachers to reach. Often schools that are successful in implementing change through the adoption model had strong leadership that can ensure some minimal technical competence of all teachers in the school. Another important value promoted in these schools was the sharing of teacher produced course materials.

All three models of change described above can be found in the secondary schools studied while only the Catalytic Integration model and the Adoption model can be found in the primary school studied. This is most likely because the Integration model is only practicable when the schools have a well established ethos and a relatively able cohort of students. Possibly because of this and the fact that ICT has only begun to be available for teaching and learning in some primary schools after summer 1998, only the Expository and Task-based approaches with some elements of social-constructivist orientation were observed in the primary classrooms that we visited. Obviously, this narrow range of observed pedagogical practices may also be an artifact of the limited number of case studies we were able to complete at the primary level for various reasons. However, we are confident that, especially in the case of primary schools, we have visited those schools that are publicly recognized as the schools with the most experience in using ICT for teaching and learning. Further the lessons we observed were selected or approved by the school principal and thus should reflect best practice as perceived by the school leadership.

While the apparent relationships between the change models and observed pedagogical practices are grounded on a limited number of case studies and it is imperative that further work on an extended scale be carried out to refine the models and to explore more deeply how school level contexts relates to the pedagogical practices present in a school, we are pleased with the initial observed systematic consistency. However, with the fast developments in ICT use in Hong Kong schools, the situation is changing everyday. We look forward to further research in this area in Hong Kong and oversea.

Conclusion

This paper describes the conceptual framework and methodological approaches used in the SITES Local Extension Study, as well as a brief description of the main findings in terms of the pedagogical practices and implementation strategies in ICT implementation in schools. Such findings have shed light on the impacts of ICT on teaching and learning in schools and also highlight some of the contextual factors that are necessary in order for good practices to be disseminated effectively.

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